Original article

The Chilgoza of Kinnaur. Influence of the *Pinus gerardiana* edible seed market chain organization on forest regeneration in the Indian Himalayas

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The Chilgoza of Kinnaur. Influence of the *Pinus gerardiana* edible seed market chain organization on forest regeneration in the Indian Himalayas.

Abstract — Context, objective and methods. In the north of India, in the Himalayas, the high-altitude slopes [(between 1800 and 3300) m] are covered by forests where *Pinus gerardiana* dominates. This pine is known for its edible seeds (Chilgoza). The recent evolution of nut harvest methods means that there is danger of the disappearance of natural seedlings and the ageing of the forests. Therefore, a survey was carried out from 1998 with a hundred farmers, which was supplemented with field visits and discussions with resource people involved in the commercial chain. **Results**. In the 1950s, traditional harvesting rules made it possible to respect trees and to allow a small portion of seeds to reach the ground. So, in spite of particularly difficult ecological conditions, the forest was able to regenerate. During the five last decades, the roads opening have allowed an irrigated cash-arboriculture development in the valleys. The village communities have become less dependent on the Chilgoza trade and sell the nut harvest contracts to private contractors who employ foreign workers, cut many branches and practically collect all the seeds. So, regeneration has become practically non-existent. The poorest inhabitants cannot have access to this resource anymore. In town, the retail sale of Chilgoza represents a market of (100 to 300) t·year^{-1}, at a price from (15 to 20) €·kg, *i.e.*, a market chain from (1.5 to 6) M€·year^{-1}. **Discussion and conclusion**. The authors put forward a proposal to substitute for the two private platforms (purchase and drying) of New Delhi an organization with a non-lucrative purpose, concerned with a more respectful socio-economic development of the environment. This unit would centralize Chilgoza buying, drying and storage in the production place. Then, it would ensure sales to urban sellers, at the time of the peak of market demand. This would allow for a more significant part of the market chain added value to remain in the valley; this money at the same time would make it possible to fight against poverty and to regenerate natural resources. The authors are campaigning to see that research and development projects, financed with national or international funds, come to support these proposals.

India / *Pinus gerardiana* / Himalayan region / highlands / seeds / nonwood forest products / natural regeneration / sustainable land management / marketing channels

Le Chilgoza du Kinnaur. Influence de l'organisation de la filière de la graine comestible de *Pinus gerardiana* sur la régénération forestière, dans l'Himalaya indien.

Résumé — Contexte, objectif et méthodes. Dans le nord de l'Inde, dans l'Himalaya, les pentes d'altitude [(entre 1800 et 3300) m] sont couvertes par des forêts où *Pinus gerardiana* domine. Ce pin est connu pour ses graines comestibles (Chilgoza). L'évolution récente des méthodes de récolte laissent craindre la disparition des semis naturels et le vieillissement des forêts. C'est pourquoi des enquêtes ont été réalisées en 1998 auprès d'une centaine de paysans de la région ; elles ont été croisées avec autant de visites de terrain et avec des entretiens avec des personnes ressource de la filière commerciale. **Résultats**. Dans les années 50, la récolte traditionnelle permettaient de respecter les arbres et de laisser une petite partie des graines atteindre le sol. Ainsi, malgré des conditions écologiques particulièrement dures, la forêt pouvait être régénérée. Au cours des cinq dernières décennies, l'ouverture de routes a permis le développement d'une arboriculture irriguée de rente dans les vallées. Les communautés villageoises sont devenues moins dépendantes du commerce du Chilgoza et ont majoritairement décidé de vendre les contrats de récolte des graines de leurs forêts à des entrepreneurs privés, qui emploient les ouvriers étrangers et font couper beaucoup de branches pour récolter pratiquement toutes les graines. Ainsi la régénération est devenue pratiquement inexistante. Les habitants les plus pauvres ne peuvent plus avoir accès à cette ressource. En ville, la vente au détail de Chilgoza représente un marché (100 à 300) t·an^{-1}, à un prix de (15 à 20) €·kg^{-1}, soit une filière de (1.5 à 6) M€·an^{-1}. **Discussion et conclusion**. Les auteurs font une proposition pour substituer aux deux plates-formes privées (achat et séchage) de New-Delhi un organisme à but non-lucratif, soucieux d'un développement socio-économique plus respectueux de l'environnement. Cet élément centraliserait les achats, le séchage et le stockage de Chilgoza sur le lieu de production. Puis, il superviserait les ventes aux vendeurs urbains, au moment du pic de la demande du marché. Une part plus importante de la valeur ajoutée resterait ainsi dans les zones de récolte; cet argent permettrait à la fois de lutter contre la pauvreté et de régénérer les ressources naturelles. Les auteurs militent pour que des projets de recherche et de développement, financés sur fonds nationaux ou internationaux, viennent appuyer ces propositions.

Inde / *Pinus gerardiana* / région himalayenne / région d'altitude / graine / produit forestier non ligneux / régénération naturelle / gestion foncière durable / circuit de commercialisation

Figure 1.
The Chilgoza pine (*Pinus gerardiana* Wall. Ex. D. Don), "noosa", or "neoza".

1. Introduction

1.1. Context

The Chilgoza pine (*Pinus gerardiana* Wall. ex. D. Don), "noosa", or "neoza" (*figure 1*), is native to north-western Himalaya; it is found in eastern Afghanistan, Pakistan and north-western India, growing at altitudes ranging between (1800 and 3300) m. It is often associated there with the Blue pine (*Pinus wallichiana*) and with the cedar of the Himalayas (*Cedrus deodara*).

Figure 2.
"Nuts" known and sold locally in India under the name of "Chilgoza".

Pinus gerardiana is well known for its edible seeds (*figure 2*), rich in carbohydrates and proteins. These "nuts" are known and sold locally under the name of "Chilgoza", "Neja" (singular) or "Neje" (plural). Chilgoza is known to be one of the most important cash crops of the tribal people who live in the district of Kinnaur, in the state of Himachal Pradesh (HP), India[1].

Chilgoza is mainly extracted from the forests of the State and, in a complementary way, from trees in private ownership. In India, although the majority of the forests were nationalized during British colonization, the villagers preserve traditional rights to the use of the natural resources. Therefore, the management of the forests of Chilgoza pine falls under the broader problems of the common forest management. The common property resources are renewable natural resources used and managed by a community, such as water for irrigation, forests, pastures, etc. These resources are used by several users, each having the same right of use, but none of them being the owner.

1.2. Aim of the study

From 1998, a study was undertaken in partnership with the National Afforestation Eco-development Board (N.A.E.B.), an Indian governmental organization, in particular in charge of the restoration of degraded forests [1], with the aim of characterizing the current "systems of harvest" of Chilgoza, *i.e.*, the organization of harvest on a village scale. More precisely, we attempted to estimate the impact of these harvest systems at a social level (equity in the division of this natural resource, financial dependence of the villagers), at an ecological level (impact on

[1] Conifer Specialist Group, *Pinus gerardiana,* in: IUCN 2008, 2008 IUCN Red list of threatened species, www.iucnredlist.org.

natural regeneration) and at an economic level (study of the ways of marketing, implication of the various actors of the market chain).

2. Materials and methods

2.1. Zone of the study

Kinnaur is a very mountainous area at the border between India (HP) and China (Tibet) (*figure 3*). This area is centered on the Satluj Valley which crosses three high mountain ranges, with many tops exceeding 6,000 m. The physical conditions of this zone are very difficult. The climate is relatively dry, on average 500 mm of precipitations per annum, with cold, snow-covered but dry winters, hot and dry springs, and hot summers marked by rare and very erosive precipitations of monsoon. The topography is very broken (*figure 4*). Sandy slopes of 30% to 80% are not very favorable to the installation of vegetation. All these factors are responsible for strong erosion.

In spite of these difficult physical conditions, agriculture is the principal activity of Kinnaur. The cropping systems remain primarily based on food crops of subsistence farming: cereals (corn, wheat, millet) and vegetables (onions, garlic, lentils, red kidney beans). However, the slopes of Satluj are favorable to the establishment of orchards of apple trees. Since 1962, the construction of a road has allowed the opening up of the zone and facilitates the export of the apple production towards New Delhi, thus supporting the expansion of this activity. Currently, the villagers are resolutely

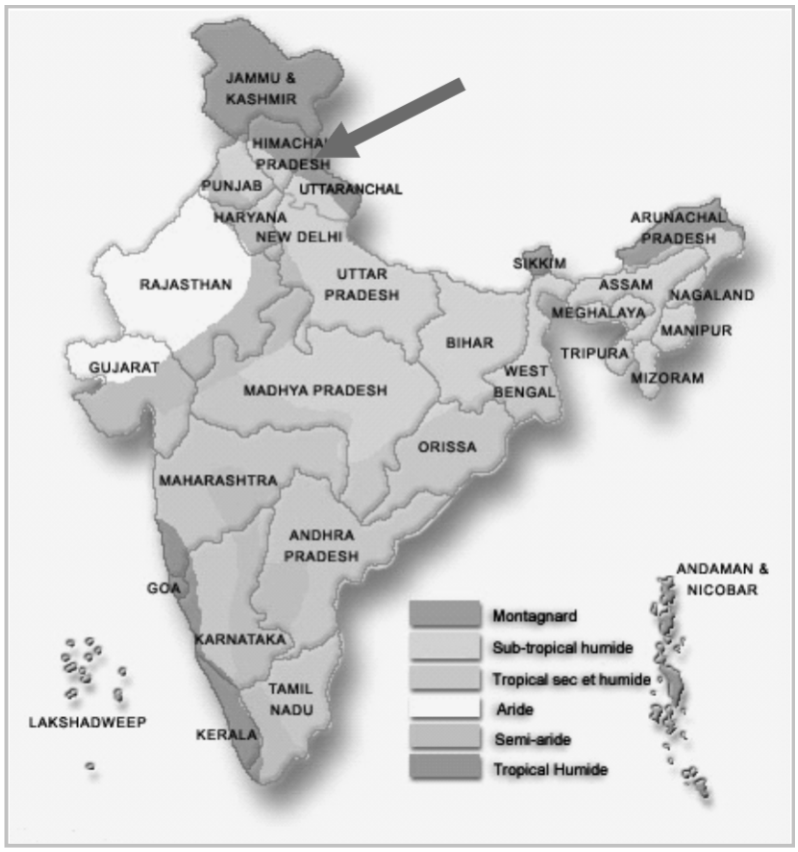

Figure 3.
Kinnaur is a very mountainous area at the border between India (Himachal Pradesh State) and China (Tibet).

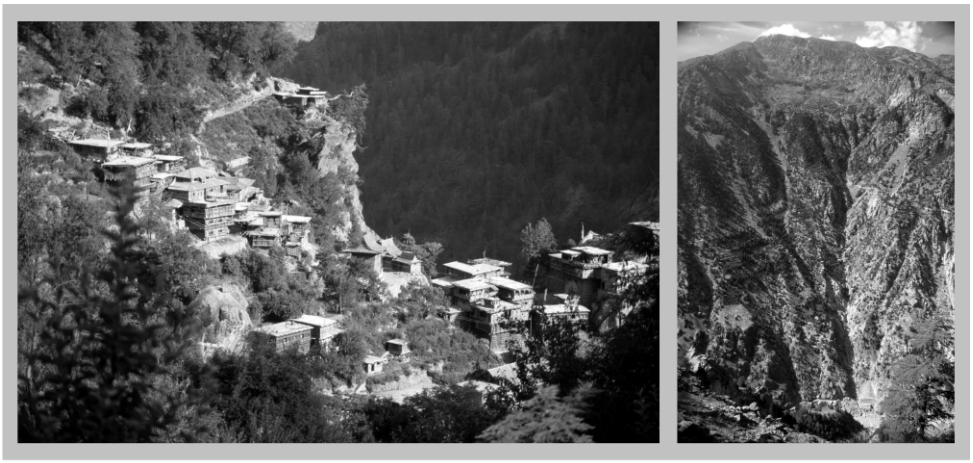

Figure 4.
Sandy slopes of 30% to 80% are not very favorable to the installation of vegetation.

engaged in fruit-orchard activity: apple trees primarily, and almond trees secondarily. In spite of this major change in agriculture, the villagers remain dependent on the common natural resources which provide them with inputs in their systems of production (fodder, mulching), and of firewood, but also of the marketable products (mushrooms and spices modestly, and primarily Chilgoza).

2.2. Methods of investigation

Our study was based at the same time on the forest management and on the Chilgoza harvest. The informal preparatory phases of the survey made it possible to identify the problems and to select the inquiry methods to be used [2]. Then, a survey was carried out with a hundred farmers of the area, to determine what their perception of the evolution was and what improvements or alternatives they could propose. The investigations were supplemented with field visits and discussions with resource people involved in the commercial chain.

Work was centered on four complementary topics:
– an analysis of the various systems of Chilgoza harvest in the villages of the study zone,
– an evaluation of the financial dependence of the villagers with respect to the Chilgoza seed harvest,
– an analysis of the Chilgoza market chain,
– an evaluation of the ecological impact of the seed harvest on the regeneration of these forests.

In order to fulfil these objectives, a socio-economic survey was carried out with various actors. These investigations primarily proceeded in the district of Kinnaur, in the Himachal Pradesh state (HP), located on the buttresses of the Himalayas, in the North-West of India. The investigations concerning the market chain were carried out between Kinnaur and the city of New Delhi, located a little more than 500 km from the study zone.

2.3. Stratification of the investigations

A first series of semi-directive inquiries was carried out with Forest Department officers, at various hierarchical levels. Then, surveys were carried out in the villages.

3. Results

3.1. The Chilgoza market chain: from production to marketing

The development of the Chilgoza market chain has accelerated since the opening up of the study zone and the Chilgoza price rise in the 1960s. Great changes have affected the modes of harvest and the ways of marketing. This market chain is still undergoing progressive transformations even today.

3.1.1. Techniques of seed harvest

In September–October, the still green cones of Chilgoza pines are collected. The men climb up the pines, and by means of a sickle cut the ends of the branches supporting the cones; those which are out of reach are left on the tree. The cones are piled up for 2 weeks in a shaded place in order to facilitate the extraction of seeds which is then carried out by means of a slicing tool: the cone is cut into four, and the seeds are extracted from each quarter. The harvest of Chilgoza seeds is a taxing activity: the pines are located on very steep slopes often difficult to access, the height of the pines is perilous and tiring, and, finally, the extraction of seeds is long and tiresome: to extract 3 kg of seeds requires approximately 1 work-hour for an experienced person. The techniques of harvest are identical over the whole of the study zone, but the organization of harvest on the village level is variable.

3.1.2. Various systems of collection

There exist various systems of collection of Chilgoza seeds, according to the level of decision. That means that the collection can be organized, in each village, either (1) on the village level, (2) on the "district" level, or (3) on the level of each household.

In the first system (1), on the village level, the Chilgoza forest attached to the village preserves its integrity. The organization of the harvest is decided either by the members

of the village council (*panchayat*), or by the members of a traditional council when it exists, or by a mutual consensus between the villagers. In all the cases, the opinion of the villagers clearly influences the organization of harvest. There exist three subsystems: (a) the harvest is carried out via contractors; the forest is divided into plots, allotted by increasing public auctions to contractors who manage the harvest. (b) The villagers collect the cones all together and equitably divide them: this is a more traditional system of collection which is tending to disappear, replaced by the modern system of the contractors. (c) In the last case, now abandoned for more than 3 years, one period of harvest was fixed at the village level during which each household could send three members into the forest to collect the cones. Then, the collected quantity depended only on the agility and the labor of the workers.

In the second system (2), on the "district" level, the forest is divided into as many compartments as "districts" exist in the village; then, a "district" is associated with each forest compartment. The villagers of a district choose by consensus the system of harvest of the cones. Two subsystems coexist: (a) each compartment of the forest is divided into several plots allotted by public auction to contractors. (b) The villagers collect the cones collectively and equitably divide them between themselves on the level of each harvest compartment.

Lastly, in the third system (3), on the household level, a portion of the forest of Chilgoza pine is allotted to each beneficiary household. Each family manages the harvest as it likes, either by using the family labor, or by using seasonal salaried labor, or by yielding one's share in the form of a contract, generally with a neighbor, given the small size of the forest plots.

3.1.3. Equity in the redistribution of the income resulting from the sale of Chilgoza seeds

By the term "equity" we understand "an equal access of each household to this resource", and, therefore, to the financial income arising from it. This equity depends on the harvest system and on "what is shared", either "the money" resulting from contracts with contractors, or "cones" in the cases of a villagers' collective harvest, or "the forest" when a forest plot is allotted to each household.

When it is about money [the cases of system (1) with subsystem (a), and system (2) with subsystem (a)], often the division is mathematical: the money is divided into as many shares as there are households, but without taking account of the size of the family unit. Moreover, the earned money does not depend on the involvement of the villagers in harvest and, therefore, each household can claim the same income. When it is about cones [the cases of system (1) with subsystem (b), and system (2) with subsystem (b)], often the division is equitable between households, but by taking account of the contribution in labor of each household. An equal number of workers is requested for each household (very often two) to carry out the harvest; if a household, for various reasons, is not able to provide these two workers, its share of cones is proportionally reduced, except if it presents a farm laborer in replacement.

In the two preceding cases, often the division is relatively equitable because the money and the cones are quantifiable elements and therefore easy to divide. Nevertheless, if a forest plot is allotted to each household, equity in the division is definitely less easy to obtain since it depends on the richness of the plots in cones. This wealth is a function of the mature tree number, their respective productivity, their accessibility, etc.

For these reasons, very often, a system of plot attribution change exists to restore certain equality in the access to this resource: it can be a question of a lottery system. In the case of a village, a system of attribution change does not exist: the village is divided into twelve segments, and the twelve corresponding compartments of forest are very unequal, according to the *panchayat* chairman (*pardhan*) of Roghi. This absence of equity currently generates conflicts among the villagers, which explains the movement, today, towards a system of collection by contractors.

3.1.4. Pre-eminence of a new system of organization of harvest based on commercial contracts

A new contract system (calling upon contractors) is beginning to be used for the Chilgoza seed harvest; at the time of an auction, all the contractors, the majority from the village concerned, are brought together. Each plot is put up for bidding, and the contractor who proposes the highest bid deals with harvest on the plot concerned. He manages the labor and, often, calls upon Bihari or Nepalese non-local laborers.

Currently, it arises from the survey that a significant number of villages has been directed towards this contract system during the ten last years.

The development of fruit-bearing tree cultivation (apple tree orchards) seems to be the leading cause of this development. The explosion of this very remunerative cash crop in the study zone has had two fundamental effects, responsible for the disinterest of the villagers with respect to the Chilgoza seed harvest. First, the apple harvest takes place simultaneously with the Chilgoza seed harvest, which implies a lack of time available on the part of the villagers. Moreover, the success of apples in the study zone has generated a rise in the monetary incomes of the households; whereas in the past the Chilgoza represented the single monetary source of revenue since the majority of the crops were intended for family consumption, the apple has become the independent source of monetary incomes. Therefore, the dependence of the villagers with respect to Chilgoza seed sale has considerably decreased, so that the need for getting a maximum profit from Chilgoza seed harvest has disappeared, which explains why a great number of villages turned, and continue to do so today, to the contract system.

However, it appears from our semi-directed surveys that the poorest villagers miss the traditional system of collection, which was certainly more lucrative for them.

3.1.5. A declining dependence of the villagers with respect to Chilgoza

By "dependence" with respect to the Chilgoza, we understand "the part of income imputable to the Chilgoza in the household budget". The downward trend of this dependence is correlated with a rise in the villagers' income. This rise is not only due to the success of the apple production but it is also explained by the creation of many governmental supplementary programs in the study zone which give priority of employment to the lower-caste villagers, often the poorest. Governmental programs to install electricity and running water provide remunerated employment for the local labor. Therefore, in the majority of the villages, the Chilgoza lost its essential place: only 30 years ago, it acted as the only monetary resource of the villagers [3]. Currently, the improvement in the villagers' living standard is accompanied by a progressive disinterest, above all of the wealthiest villagers. Moreover, the abundance of cheap foreign labor for the agricultural work accentuates this disinterest.

However, according to in-depth surveys carried out in two villages, it arises that this "level of dependence" varies much from one village to another. In the villages of the East of the study zone, on slopes exposed to the south, the villagers are still relatively dependent on Chilgoza, which represents more than 25% of the budget for certain households. In this zone, very restricted water availability did not allow a very significant development of arboriculture. In this precise case, the contribution of the financial income resulting from apple sales is less significant.

Overall, in the zone, the share of the financial income due to the Chilgoza in the total financial income of the household varies between 5% and 25%; this share can exceed 25% for the poorest villagers.

3.1.6. The marketing of Chilgoza nuts

The Chilgoza nut market chains are multiple. The villagers sell their production in priority to itinerant merchants, either in Rekong Peo, the main town of the Kinnaur district, or directly in their own village prospected by the itinerant merchants; it is the most current case with Jangi, the most distant village from Rekong Peo. Since they have a larger quantity of Chilgoza nuts, the contractors, just as the itinerant tradesmen, prefer to directly sell them in New Delhi,

where two agents of commission ensure this sale. It is about a redistribution platform: all Chilgoza nuts produced in Kinnaur go through these two agents, subtracting a minor share (probably lower than 10%) directly sold by the villagers in a fair in Rampur during the religious holiday of *Lavi*.

The intermediaries, who then buy the Chilgoza nuts, only carry out a single transformation in the market chain: nuts are quickly brought up to a very high temperature, in order to harden the mantle to stop a rapid and significant loss of moisture. This moisture loss explains why the first part of the marketing is very fast, and why the margins which the itinerant tradesmen allow are significant. After this transformation, the retailers can buy the Chilgoza nuts and sell them without the risk of weight loss, and thus profit loss.

Chilgoza is primarily marketed in the north of India, at a high price, varying from (15 to 20) €·kg^{-1}. The marketing of Chilgoza nuts is seasonal: they are primarily sold during the religious holiday of *Divali*, during which all kinds of dried fruits are offered as presents to the family. Chilgoza nuts are bought by rich consumers, especially in New Delhi. The increasing demand for Chilgoza nuts started a strong price increase; consequently, many tradesmen are interested in this market. Although the "monetary dependence" of the villagers with respect to Chilgoza has been reduced, the harvest of this expensive nut remains very lucrative.

3.2. The degradation of the pine forests

Currently, from the inventories carried out during our study, we observe that natural regeneration in Chilgoza pine forests is almost non-existent. Declarations of Forest Department civil servants corroborate this observation and this irrefutable fact has already been underlined since 1960 [3]. The only factor harmful for the Chilgoza pine regeneration, which has increased considerably since the fifties, is the over-harvesting of this pine; the seed overexploitation is responsible for the low current level of natural regeneration. Very few cones, and therefore seeds, reach the ground and allow natural regeneration.

3.2.1. Impact of the harvest system on natural regeneration

For the Chilgoza pine forests, anthropic pressure is directly correlated with the nut harvest system. Indeed, it emerges from surveys led in the villages having preserved a traditional harvest system that the harvest carried out by contractors is more "destructive". Villagers who collectively lead harvest are often less available and involved than the contractors. In addition, to preserve the resource, they limit in particular the disbranching (pruning) which is usually carried out to reach inaccessible cones. On the contrary, often the contractors have fewer scruples: in all the cases, the harvest that they carry out is more harmful for natural regeneration than a traditional harvest carried out by villagers.

The movement of the traditional collection systems towards a contract system explains why this phenomenon of overexploitation, already a key factor, can only worsen in the years to come. Moreover, the opening up of the villages towards contractors coming from outside can be currently observed, even made aware of their responsibilities regarding this problem of natural regeneration degradation. A contractor often is concerned only with his annual contract without concern for the future cone production, with more powerful reasons when he does not belong to the village. In addition to these principal factors, other factors accentuate the Chilgoza natural regeneration problem.

3.2.2. Factors responsible for the low level of natural regeneration

The persons in charge of the Forest Department of the state of Himachal Pradesh estimate that natural regeneration is not sufficient for a renewal of the forest, except in very sloped zones, which would account for only 5% of the surface covered by the Chilgoza pine. This confirms the observations made in Pakistan [4, 5]. To its overexploitation, other biotic and climatic factors are added which accentuate the poverty of natural regeneration.

Figure 5.
The forest services of the State have carried out some plantations but those have a very limited surface area and rate of success, due to a lack of means.

Although the branches of adult Chilgoza pine are not edible by cattle, the young seedlings are attractive to and grazed by domestic cattle, which cause the mortality of an already established regeneration. Two other biotic factors are added to these anthropic factors: (1) two parasitic insects, *Dioryctria abietivorella* (Grote), the Fir cone-worm [6], and *Euzophera cedrela*, the Cedar cone-moth [7], lay in the cones and their larvae consume seeds rich in proteins, and (2) various rodents, birds (*Nucifraga caryocatactes* subsp. *multipunctata*), the Eurasian nut-crackers [8] or lizards consume seed fallen on the ground, not allowing establishment for regeneration. Because of its epigeous germination, the cotyledons of seed, just after germination, can be consumed by certain birds.

Moreover, the climatic conditions are very harsh, and springs (and sometimes summers) very dry. This is why a Chilgoza pine spends two years establishing its root system. During its first two years, it remains exposed to climatic risks and sensitive to severe dryness. Once its top root is established, the pine is able to resist dryness.

3.2.3. Actions of the forest department to stop this phenomenon

Since the sixties, the Forest Department has been interested in the problem of Chilgoza pine regeneration. Its forest policy is resolutely directed towards the conservation of these forests. However, rather than sticking to the roots of the problem, the overexploitation of seeds, the Forest Department turned to artificial pine plantations. The techniques of seedbeds and transplantation have gradually improved during the last thirty years. Today, these techniques make it possible to grow the pine in seedbeds more easily, and to transplant it by disturbing the root system as little as possible. However, the plantations continue to encounter a relative failure even today (*figure 5*). The cost of these plantations (from the sowing of seed until planting) has increased, because they require a lot of labor: producing a seedling and planting costs approximately 0.25 €. After planting, the Chilgoza pine requires follow-up for 2 years, in particular regular irrigation and partial weeding, to facilitate the establishment of its root system. Nevertheless, the Forest Department, on the zone level, does not have the financial means to ensure the follow-up. Moreover, the involvement of villagers remains weak, even non-existent; often they are ready not to let their cattle graze in the plantations carried out, but do not feel absolutely concerned by their conservation. Thus, in many villages, the farmers do not allow the Forest Department to use water necessary for the plantation irrigation, from their own private channels.

4. Discussion

4.1. How to stop this process of degradation

Any project intended to stop or slow down this process of forest degradation must be necessarily based on the participation of the villagers. Indeed, the Forest Department does not have financial and human means to lead projects without their agreement, because, with regard to the Chilgoza cone harvest, the beneficiaries do not have a restriction, and their participation is also necessary in projects of participative afforestation, for example. Therefore, it would be necessary to initially estimate up to what point the villagers are conscious of the

impact upon their environment which this deficit of natural regeneration would involve in the long term, *i.e.*, a progressive ageing of the forest in place, then its disappearance, with the erosion problems that would be involved.

After this preliminary study, various projects could be set up. A rotation system in harvest could be established, *i.e.*, at the level of each village, part of the Chilgoza pine forest would not be exploited each year, in order to allow a maximum of seeds to reach the ground. In order to promote natural regeneration, this forest management had already been tried by the Forest Department, but the villagers had been opposed to this action and had not respected it. The seed protection could be supplemented by some plantations of zones without seed-bearing trees and by grazing prohibition for four to five years.

4.2. Proposal for an establishment of a regulatory organization at a key point of the market chain

The study of the Chilgoza market chain, in particular of the ways of marketing, made it possible to isolate a key point: in New Delhi, the basic essentials of the production proceed by two commission agents before undergoing a transformation intended to stop the seed moisture loss. A key idea of a project would be to substitute, for these private distribution platforms, a non-lucrative organization (NGO type or cooperative) concerned with a more balanced and more respectful socio-economic development of the environment. This organization, which would centralize the production of Chilgoza seeds, would ensure drying at high temperatures. This unit could be established directly in the production place [the total production of Chilgoza seeds consumed by New Delhi represents from (100 to 300) t per year].

The aims of this establishment would be multiple:

– First of all, to improve the remuneration of the inhabitants of Kinnaur, by limiting the number of intermediaries in the market chain, by reducing the seed weight loss due to transportation to Delhi, and by improving the distribution system of Chilgoza seeds.

– To have an impact on the upstream of the industry, *i.e.*, on the Chilgoza seed harvest: if the organization really manages to establish a monopoly, it would consequently have the means of exerting a pressure on producers, or at least of adopting a strategy of incentive (premium for the "harvest quality", premium for respecting the quotas). All these activities of incentives could be communicated by public awareness campaigns carried out directly for the villagers or concerned associations, but also for the contractors and farm laborers,

– To have an impact downstream from the market chain while trying to stabilize the market, while controlling each year the Chilgoza marketed quantities, in particular by a quota policy. Moreover, an improvement in the capacities and in storage effectiveness could allow running the Chilgoza seed production only during the peak of consumption of the Divali festival, in order to obtain the best possible value for the product.

– Finally, such a unit could deliver to the product a label of sustainable management and equity, knowing that urban consumers and those most financially secure are increasingly concerned about this type of certification.

4.3. Proposal based on the Indian and African experience of village associations for sale of Non-Wood Forest Products (NWFP)

In India, in 2003, a decade after initiating the Joint Forest Management (JFM), evaluations of this program indicated that huge progress had been made in terms of the number of Forest Protection Committees (FPCs) formed (nearly 63 000) [9], which covered an area of about 15 Mha. Nevertheless, the number of FPCs functioning is very low. Lack of community participation, ineffective leadership, lack of statutory institutional support, and tenurial security are the major concerns that need to be addressed to make the JFM effective. Capacity building is an issue that needs strengthening. The evaluation reports

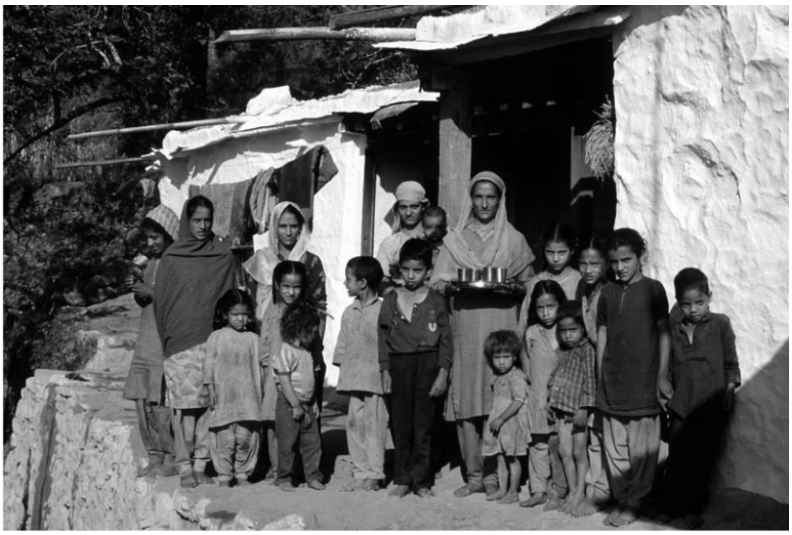

Figure 6.
The sustainable management of the Kinnaur forests (India) could reduce poverty.

have shown a huge potential for generating employment in the JFM program, which, in turn, will reduce seasonal migration of landless labor. However, the income-generating activity in the JFM was not improved to the expected level, perhaps due to the poor links between produce availability and market channels. The focus of the individuals has to be changed from the short-run to the long-run concerns by providing them with a suitable alternative means of livelihood [10].

In addition, concerning the market chain upstream organization of the NWFP in common property, the experience gained by the French Agricultural Research Center for International Development (CIRAD) in Central Africa, as by many organizations throughout the world [11], shows the possibility for solutions which could be attempted in Kinnaur.

The African examples relate to various products such as, for example, the leaves of the Doum palm tree in Niger [12] or shea tree butter in Cameroon [13]. In these cases, the inhabitants were organized in village associations (VA) in which all the groups are represented (traditional authorities, farmers, stockbreeders, women, young people, rich farmers, poor landless peasants, etc.). The State delegated to these associations the forest management, provided that those forests are managed in a sustainable way, are socially equitable, and that the regeneration of the natural resource is assured [14]. The NWFP are marketed in a way grouped into a storage and sale common purchasing agency where they receive a first transformation, easily realizable in the village. This makes it possible to sell a higher value product when the market is high. A more significant part of the added value thus remains in the harvest zones. Taxation raised directly by the village associations on the sale of NWFP allows, on the one hand, financing the government officials in charge of control; and, on the other hand, carrying out forest regeneration actions; and, finally, carrying out various local development actions, freely chosen by the village association assemblies.

The authors hope that research and development projects, financed with national or international funds, will come to support these proposals, by organizing the chain of Chilgoza seeds, in order to ensure the regeneration and the sustainable management of the Kinnaur forests and to reduce poverty (*figure 6*).

5. Conclusion

Currently, there is not sufficient natural regeneration in the Chilgoza pine forests, and plantation programs led by the Forest Department are not widespread enough and especially not yet effective enough to consider a renewal of the forest. This forest has not yet come to a stage of senescence, but such a catastrophic scenario is envisageable if no project makes it possible to restore sufficient natural regeneration. Our study has attempted to analyze exactly the context of the harvest of Chilgoza seeds. Moreover, it made it possible to alter the preconceived idea, certainly true in the past, that the villagers remained very dependent on the financial income of the Chilgoza product. The knowledge of all this economic context of Chilgoza upstream of the market chain must make it possible to choose suitable modes of action to carry out a more adapted project.

Complementary studies must be carried out to this end. For a deeper understanding,

they could be in particular directed around two main research areas:

– a real estimate of the settlement age, and of the regeneration level necessary and sufficient to ensure the renewal of the forests of *Pinus gerardiana*, perhaps by assessing a minimal number of healthy cones to preserve on the tree each year by taking account of all the other factors affecting regeneration,

– a feasibility assessment of the establishment project for a cooperative or a NGO in the marketing and organization chain of producers in village associations.

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El Chilgoza del Kinnaur. Influencia de la organización de la filial de la semilla comestible de *Pinus gerardiana* en la regeneración forestal, en el Himalaya indio.

Resumen — Contexto, objetivo y métodos. En el norte de la India, en el Himalaya, las pendientes de altitud [(1800 y 3300) m] están cubiertas de bosques donde domina el *Pinus gerardiana*. Se conoce este pino por sus semillas comestibles (Chilgoza). La reciente evolución de los métodos de cosecha hace temer la desaparición de las siembras naturales y el envejecimiento de los bosques. Po resta razón se llevaron a cabo sondeos en 1998 a cerca de cien campesinos de la región; se han mezclado con otras tantas visitas de terreno y con entrevistas a personas que son recurso de la filial comercial. **Resultados**. En los años 50, la cosecha tradicional permitía respetar a los árboles y dejar una pequeña parte de las semillas alcanzar el suelo. A causa de esto, y a pesar de las condiciones ecológicas particularmente duras, el bosque lograba regenerarse. A lo largo de las cinco últimas décadas la apertura de rutas permitió el desarrollo de una arboricultura irrigada de renta en los valles. Las comunidades lugareñas se volvieron menos dependientes del comercio del Chilgoza y decidieron mayoritariamente vender los contratos de cosecha de semillas de sus bosques a los empresarios privados que contratan obreros extranjeros, ordenan podar muchas ramas para cosechar prácticamente todas las semillas. De este modo, la regeneración se ha vuelto prácticamente inexistente. Los habitantes más pobres ya no pueden tener acceso a este recurso. En la ciudad, la venta minorista de Chilgoza representa un mercado de (100 a 300) $t \cdot an^{-1}$, a un precio de (15 a 20) $€ \cdot kg^{-1}$, es decir una filial de (1.5 a 6) $M€ \cdot an^{-1}$. **Discusión y conclusión**. Los autores hacen una propuesta para sustituir ambas plataformas privadas (compra y secado) de Nueva Delhi por un sólo organismo sin ánimo de lucro, preocupado por un desarrollo socioeconómico más respetuoso con el medioambiente. Dicho elemento centralizaría las compras, el secado y el almacenamiento de Chilgoza en el lugar de producción. Asimismo supervisaría las ventas a los vendedores urbanos, en el momento pico de la demanda del mercado. Una parte más importante del valor añadido permanecería de este modo en las zonas de cosecha; este dinero permitiría a la vez luchar contra la pobreza y regenerar los recursos naturales. Los autores militan para que proyectos de investigación y de desarrollo, financiados por fondos nacionales o internacionales, vengan a apoyar estas propuestas.

India / *Pinus gerardiana* / región Himalaya / zona de montaña / semilla / productos forestales no lenosos / regeneración natural / ordenación de tierras sostenible / corrientes de mercadeo